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A Comparative Study of User Experience between Physical Objects and Their Digital Surrogates

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Introduction

Librarians and archivists have embraced innovative technologies that provide users a way to access a variety of collections. Social media increases that engagement by allowing users to share digital collections while bringing visibility to cultural institutions. While new technologies improve the effectiveness of image retrieval systems, little has been done to understand the human experience with the physical object. While library and information scientists make strides toward designing new ways to access digital collections, is there a loss of sensory engagement (sight, touch, sound) and emotional experience? Spinoza, as cited by Megan Watkins, attempts to define the experience between the user (the affectus) and an object (the affectio).[1] Emotions are subjective in nature and can be difficult to interpret. Physical objects can stimulate critical and analytical thinking, arouse us, engage us, and play an important role in our emotional and social development.[2] Emotions are what sustain and preserve the connection between ideas, values, and objects.[3] This study explores user experience with physical objects and their digital surrogates. The objectives are (1) to identify any similarities or differences in user experience with physical and digital artifacts; and (2) to offer information specialists new insights into the experiential affect of user experience with physical artifacts and their digital surrogates.

Literature review

A successful digital library requires three components: the information architecture, a preservation component, and robust metadata.[4] Media theorist Lev Manovich believes that aesthetics and information visualization are important aspects of digital collections.[5] Studies that measure Human Computer Interaction (HCI) and user experience are more apt to focus on the negative experience with the interface than the positive.[6] The subjective side of user experience is not addressed sufficiently nor does it take into account the user experience or hedonic attributes (i.e., stimulation, identification).[7]

User studies with physical objects are found in a variety of disciplines such as psychology, museum studies, and product design. From the Department of Industrial Design at the Delft University of Technology in the Netherlands, Desmet and Hekkert introduced a general

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[1] Megan Watkins, "Desiring Recognition, Accumulating Affect," in *The Affect Theory Reader*, ed. Melissa Gregg and Gregory J. Seigworth (Durham, NC: Duke University Press, 2010), 269.
[2] Camic, Paul M. "From Trashed to Treasured: A Grounded Theory Analysis of the Found Object," *Psychology of Aesthetics, Creativity, and the Arts* 4, no. 2 (2010): 85, 90.
[3] Sara Ahmed, "Happy Objects," in *The Affect Theory Reader*, ed. Melissa Gregg and Gregory J. Seigworth (Durham, NC: Duke University Press, 2010), 29.
[4] Howard Besser, "The Next Stage: Moving from Isolated Digital Collections to Interoperable Digital Libraries," *First Monday* 7, no. 6 (2002): http://firstmonday.org/ojs/index.php/fm/article/view/958/879.
[5] Lev Manovich, "Interaction as an Aesthetic Event," *Vodafone, Receiver Magazine* 17 (2006): 2.
[6] Ann Blandford and George Buchanan, "Usability of Digital Libraries: A Source of Creative Tensions with Technical Developments," *IEEE Technical Committee on Digital Libraries Bulletin* 1, no. 1 (2003): 4.
[7] Marc Hassenzahl, "The Interplay of Beauty, Goodness, and Usability in Interactive Products," *Human-Computer Interaction* 19, no. 4 (2004): 345.

framework for product experience that revealed three components—emotional response, aesthetic pleasure, and meaning-making.[8] This framework explains the personal and layered nature of users' experience with products. Although Desmet and Hekkert's research targets product designers, it offers the information specialist insight into the emotional psychology of users and how objects can elicit emotion. In a study to determine the connection between users and found objects, researchers discovered that humans seek to create an emotional or personal experience by adding context or framework to give personal meaning to the object.[9] Studies conducted on user experience with material objects against their digital counterparts revealed that although most users found the online digital materials useful, it was also important to have access to the physical object.[10] Meaningful experience is a cognitive process of interpretation, memory retrieval, or personal attachment to an object.

Studies of affective metadata for museum collections address the practical application of user-generated metadata or folksonomy. Researchers from the National Archives of the Netherlands analyzed image database user-generated metadata from comments as these tended to offer a higher semantic value. Although user studies have validated the importance of personalizing content that contain user-generated metadata, discipline-specific vocabularies, and taxonomies, some of these are difficult to incorporate into the existing museums' metadata schema.[11] Metadata is a tool not only for the information specialist to manage and preserve collections but also for the user. Therefore, metadata must be fluid and adjusted to the needs of the user.

Past user studies with digital collections have focused on the aesthetics and ease of use and usability of the interface yet have not addressed the subjective side of user experience sufficiently. User studies with physical collections are limited in the LIS field yet abundant in the marketing field (product research) and the cognitive sciences. These studies focus on how users construct meaning in relation to objects through the personal and layered nature of user experience. This study will investigate and compare the similarities and differences in user experience between physical and digital objects through object aesthetics, emotional experience using everyday language, and meaningful experience through interpretation, memory, and personal narratives.

Theoretical Framework Used to Measure User Experience

Two theories and one concept were used to design the theoretical framework for this study: thing theory, which draws attention to things and the meanings placed upon them; theory of affect,

[8] Pieter Desmet and Paul Hekkert, "Framework of Product Experience," *International Journal of Design* 1, no. 1 (2007): 60.
[9] Camic, "From Trashed to Treasured," 86.
[10] Wendy Duff and Joan M. Cherry, "Use of Historical Documents in the Digital World: Comparison with Original Materials and Microfiche," *Information Research* 6, no. 1 (2000): 11, http://www.informationr.net/ir/6-1/paper86.html.
[11] Seth Van Hooland, "From Spectator to Annotator: Possibilities Offered by User-Generated Metadata for Digital Cultural Heritage Collections," Paper presented at the conference "'Immaculate Catalogues': Taxonomy, Metadata and Resource Discovery in the 21st Century," at the University of East Anglia, Norwich, September 13–15, 2006, p. 13.

which draws attention to the body and emotion; and numen-seeking behavior, an epiphanic experience between the user and the object.[12]

One needs an affect to create an emotion, negative or positive, regardless of its intensity. Affect encompasses passions, moods, feelings, and emotions, and is a recurrent theme throughout the history of philosophy.[13] Spinoza, as cited by Shouse, defines affect not as an emotion, but as a precursor to emotion in which the body, without thought, has a reaction to a memory, object, or event.[14] Latham's work on numinous experiences with museum objects defined this phenomena as a state of mind or consciousness that is made up of two elements: mysterium tremendum (feelings of awe) and fascination.[15] This phenomenon was first described in Rudolph Otto's book *Das Heilige* (translated into English as *The Idea of the Holy*) in 1917. *Das Heilige* defined the "non-rational" behavior in religious studies as numinous.[12] Four affects of experience were identified (sensual, emotional, spatiotemporal, and numinous), which together contain six multi-dimensional attributes (see table 1).

The sensual affect is the user's emotional and sensorial reaction to the physical objects' tangibility. Its two attributes are (1.1) aesthetics and (1.2) curiosity/novelty. Aesthetic attributes are the object's physical qualities experienced through sight and touch (active manipulation). Hand/object manipulation may involve lifting, pulling, closing, rotating, or turning. Within the digital space, this is identified as scrolling or zooming. Curiosity or novelty relates to the user's reaction to the object's unique characteristics. The emotional affect has two attributes: (2.1) inquisitive/interpretive thinking and (2.2) emotions/feelings. The former is a by-product of the user's connection with the object through its aesthetics or novel qualities. Emotions or feelings (state of mind) are the effect the object may have on the users, such as joy or sadness or a feeling of satisfaction or excitement. Spatiotemporal affect is defined as (3) transporting the user to a specific time or place in history. Users construct meaning by attaching memories (mnemonic) or narratives to make sense of the object. Lastly, a numinous quality has a (4) transforming effect upon the user manifested in a sense of awe, wonderment, or fascination.

[12] Eric Shouse, "Feeling, Emotion, Affect," *M/C Journal* 8, no. 6 (2005), para. 5, http://journal.media-culture.org.au/0512/03-shouse.php; Catherine M. Cameron and John B. Gatewood, "Seeking Numinous Experiences in the Unremembered Past," *Ethnography* 42, no. 1 (2003): 57; Kiersten F. Latham, "Numinous Experiences with Museum Objects" (PhD diss., Emporia State University, 2009), 10.

[13] Marguerite La Caze and Henry Martyn Lloyd, "Editor's Introduction: Philosophy and the 'Affective Turn,'" *Parrhesia* 13 (2011): 1.

[14] Shouse, "Feeling, Emotion, Affect," para. 4.

[15] Latham, "Numinous Experiences," 11.

[12] Ibid., 11–13.

Table 1. Definitions of Affects on User Experience and Their Corresponding Attributes				
Affect	**Definitions**	**Attributes**		**Definitions**
Sensual	The visual and sensorial aspects of the physical object through touch and can include all five senses.	1.1	Aesthetics attributes	Affect through visual and tangible experience (manipulation).
		1.2	Novelty/ Curiosity	Unique features and unusual or novel qualities.
Emotional	An emotional effect a user has with the objects.	2.1	Inquisitive/ Interpretive	To provoke analytical thinking or to reflect upon.
		2.2	Emotions/ Feelings	Real and/or imagined emotions (joy, fear, sadness) or feelings (state of mind) such as satisfaction or contentment.
Spatiotemporal	Transporting the user into a specific time or place in history.	3	Connections	Making connections through memory of experiences. Creating a story or narrative.
Numinous	Arousing an epiphanic experience between the user and the object.	4	Transformation	To have a transforming effect such as awe, wonderment (mysterium tremendum) or fascination (drawn to or transformative). To awaken one's deep emotions.

Research Questions

User interaction with information retrieval (IR) technology within the context of human information-seeking behavior is the key foundation of the information science field.[13] As in libraries, archives and special collections are designed to be information-rich with meaning-making materials for a broad range of users. This study will attempt to answer the following research questions:

1. How does the user describe multi-dimensional experiences with physical/digital objects and what are the differences or similarities?
2. How does the user construct meaningful experiences with physical/digital objects?
3. What specific elements of the physical and digital objects engage the user?

[13] Amanda Spink, "Toward a Theoretical Framework for Information Science," *Information Science Research* 3, no. 2 (2000): 74.

Methodology

Participants

Twenty respondents (N=20) were recruited from a large university in the southern New England area to participate in an exploratory study to compare user experience with physical and digital objects. Of the twenty respondents, ten were digital immigrants and ten were digital natives. Digital immigrants (DI), early and late adopters of web 2.0 applications, are defined as those who were born before the advent of the Internet who may seek information through print media before turning to the Internet.[14] They are more methodical in their search and are results-driven. Digital natives (DN), also called Millennials or Gen Y, have spent most of their lives around technology and have a need for immediacy as they are used to receiving information quickly.[15] The digital natives were identified as group A, ages 18 to 29, and had a mean age of 25.1 years (maximum SD=27.48 | minimum SD=22.72). The digital immigrants were identified as group B, ages 30 to 60, and had a mean age of 49.6 years (maximum SD=58.2 | minimum SD=40.98). All users had some experience with digital tools. The males represented a smaller proportion of the sample (n=3) than did women (n=17). Two participants identified themselves as faculty, eleven identified themselves as staff, and seven identified themselves as students (one junior, six graduates). Academic majors varied, as did job titles (see table 2). This is a purposive study as all the participants came from the same university environment.

Collections

Six artifacts were used in the study. Two black-and-white photographs representing simple two-dimensional objects, two small buttons representing simple three-dimensional (3D) objects, a tin mask of unknown ethnic origin representing a complex 3D object, and an altered book representing a highly complex interactive 3D object. Each object was accompanied with documentation (print and digital).

The university provided the digital documentation and raw NEF (Nikon Electronic Format) files of the photographs, buttons, and tin mask. A professional photographer outside the university provided high-resolution TIFF (tagged image file format) files of the altered book. All digital images were converted to JPEG (Joint Photographic Experts Group) files optimized for the web. A simple interface was created to navigate the online collection using a "drop and drag" website-building program on Firefox browser version 36.0. Participants were allowed to handle all physical artifacts without the hindrance of white cotton gloves.

[14] Marc Prensky, "Digital Natives, Digital Immigrants: Part 1," *On the Horizon* 9, no. 5 (2001): 2.
[15] Ibid., 3.

Table 2. Demographics				
Participant #	**Sex**	**Status**	**Age Range**	**Discipline**
A.diph.01	Female	Graduate	24–29	American Studies
A.diph.02	Male	Graduate	24–29	Public Health
B.diph.03	Female	Faculty	42–47	Professor of Political Science
B.diph.04	Female	Staff	54–60	Research Administrator
A.diph.05	Female	Staff	24–29	Student Affairs Department
A.diph.06	Female	Graduate	24–29	Adult/Higher Education
B.diph.07	Female	Staff	54–60	Accounting Specialist
B.diph.08	Male	Staff	54–60	Scheduling
A.diph.09	Female	Junior	24–29	Nursing
A.phdi.10	Female	Graduate	18–23	English
A.phdi.11	Female	Graduate	24–29	Social Work
A.phdi.12	Decline	Staff	18–23	Community Engagement
A.phdi.13	Female	Staff	24–29	Staff-Resident Director
B.diph.14	Female	Staff	42–47	Project Analyst
B.phdi.15	Female	Staff	42–47	Alumni Director
B.phdi.16	Female	Faculty	54–60	Professor of Nursing
B.phdi.17	Female	Staff	30–35	Admissions
B.phdi.18	Female	Staff	48–53	Nurse Practitioner
B.phdi.19	Male	Staff	48–53	Public Safety Dispatcher
A.phdi.20	Female	Graduate	18–23	Community Planning and Development

Protocol and Procedure for Interviews and Recordings

Due to the comparative/exploratory nature of this study, the researcher chose a mixed-method phenomenological approach. This included a pre-survey questionnaire, semi-structured open-ended interview questions, use of Likert scales and time measurements, and video/audio recordings. Phenomenological inquiries through the semi-structured open-ended questions help the researcher understand participant experiences, thoughts, and feelings through the users own point of view.

The pre-survey questionnaire analyzed demographics such as gender, age, status, and academic discipline along with questions to ascertain the user's experience and/or level of knowledge working with special collections. These were followed by the user experience sessions. To reduce cognitive load and minimize divided attention during these sessions, a "think after" protocol was used.[16] In an attempt to avoid any preference for one platform over another, half of

[16] Jennifer L. Branch, "Investigating the Information-Seeking Processes of Adolescents: The Value of Using Think Alouds and Think Afters," *Library & Information Science Research* 22, no. 4 (2000): 372. The think-after verbal protocol is part of the post-interview questions. Branch recommends the think-after method as a set of "wrap-up" questions that allows the researcher to collect the most complete data possible.

Group A (DN) and Group B (DI) started with the digital surrogates (identified as .diph) while the other half of these two groups began with the physical objects (identified as .phdi).

An iMac computer with built-in webcam, wireless keyboard, and mouse was used during the pre-survey questionnaire. Techsmith's Camtasia™ software version 1.2.3 utilizing the iMac's built-in webcam recorded the digital sessions. Recordings monitored time, mouse movements (scrolling up/down or zooming in/out), facial expressions, and any recorded speech. A video application for the iPad 2 recorded participants studying the physical objects and observed facial expressions and physical movements relevant to the experience. The researcher was present at all times writing additional observational notes. After each session, the user was asked to rate their experience using a Likert Scale of one to seven (one representing negative and seven representing very positive). This was followed by semi-structured open-ended interview questions (appendix A) and recorded using the AudioNote application for iPad 2 for accurate transcription analysis.

Data Analysis

Time notations measuring how long users spent on each platform generated the quantitative data. These numbers were used to measure any significant difference between digital and physical collections using age, rating, and time. A one to seven Likert scale used to rate experience also generated quantitative data using the mean average to determine if there was any significant difference between the physical and digital platforms.

Transcribed semi-structured open-ended interview questions were analyzed using a two-step open coding method. This method investigated the subjective qualities of human experience through emotions recalled or experienced. The first step involved reading the transcripts to identify the four major affects (sensual, emotional, spatiotemporal, numinous). The second step identified the six attributes of the four affects (aesthetics, novelty, inquisitive/interpretive thinking, emotions/feelings, connections, and transformation) assigned to a word, phrase, or sentence.

Results

Quantitative Statistical Analysis

Statistical analysis revealed no overall significant difference between times spent on digital and physical objects overall. However, correlation analysis to examine the relationship between ages of the users, their digital and physical rating score, and digital/physical times spent with collections showed significant differences. Results indicated there was a positive correlation between age, $r = 0.472$, $n = 20$, $p = .036$ at the 0.05 level two-tailed. This suggests the older the user is (DI), the more time they will spend studying the digital objects. Results also show a positive correlation between time spent on digital collections and rating score for digital use, $r = .607$, $n = 20$, $p = .005$ at the 0.01 level two-tailed. This suggests the users who spent more time on the digital collection tended to rate a higher score for digital use (see table 3).

Table 3. Independent T Correlations						
		Age	**PhysRate**	**DigitRate**	**PhysTime**	**DigTime**
Age	Pearson Corr	1	.045	.228	-.065	**.472***
	Sig. (2-tailed)		.852	.334	.785	**.036**
	N	20	20	20	20	20
Physical Rating	Pearson Corr	.045	1	-.123	.139	-.042
	Sig. (2-tailed)	.852		.604	.560	.862
	N	20	20	20	20	20
Digital Rating	Pearson Corr	.228	-.123	1	-.254	**.607****
	Sig. (2-tailed)	.334	604		.280	**.005**
	N	20	20	20	20	20
Physical Time	Pearson Corr	-.065	.139	-.254	1	-.123
	Sig. (2-tailed)	.785	560	280		.605
	N	20	20	20	20	20
Digital Time	Pearson Corr	**.472***	**-.042**	**.607****	-.123	1
	Sig. (2-tailed)	**.036**	**.862**	**.005**	.605	
	N	20	20	20	20	20

Age significantly correlated with Digital Time (+); Digital Time is correlated w/ Digital Rating (+)
*Correlation significant at the 0.05 level (2-tailed); **Correlation significant at the 0.01 level (2-tailed)

During an independent sample t-test (see table 4), group statistics show a statistically significant difference in physical time, digital time, and overall rating. The results suggest that when users start with physical collections first, they spent more time on them than the digital collections, showing a mean of 964.3 for physical and 451.2 for digital. However, when users started with the digital collections, they tended to spend more time with them than the physical collections, showing a mean of 1150.0 for digital and 621.7 for physical. Overall, the time spent on the digital collections was significantly higher than with physical collections, showing a mean of 12.55 (digital) and 11.55 (physical).

Table 4. Group Statistics					
	Sequence	**N**	**Mean**	**Std. Dev.**	**Std. Error Mean**
Physical Time	Digital First	10	**451.2000**	258.14544	81.63274
	Physical First	10	**964.3000**	474.14954	149.93925
Digital Time	Digital First	10	**1150.1000**	620.72454	196.29029
	Physical First	10	**621.7000**	293.00893	92.65756
Digital Rating	Digital First	10	5.9500	.49721	.15723
	Physical First	10	5.0500	1.06589	.33706
Rating Total	Digital First	10	**12.550**	.95598	.30231
	Physical First	10	**11.550**	1.01242	.32106

Using a seven-point Likert scale to rate user experience (one being negative and seven being very positive), data revealed that digital natives and digital immigrants all rated user experience viewing physical objects in the upper scale of positive use (five, six, or seven). When rating user experience with digital objects, ratings were spread across the Likert scale. One participant (digital immigrant) rated seven for very positive while another participant (digital native) rated a

three for somewhat negative. The remaining eighteen participants ranked user experience between four and six (see table 5).

Table 5. Rating Experience between Physical/Digital Objects (Likert Scale 1–7)				
Value	**Frequency (# of users)**	**Percentage**	**DN**	**DI**
Physical Objects				
5	2	10%	0	2
6	5	25%	5	0
7	13	65%	5	8
Digital Objects				
3	1	5%	1	0
4	2	10%	1	1
5	3	15%	1	2
5.5	2	10%	1	1
6	11	55%	6	5
7	7	5%	0	1

Qualitative Analysis

Sensual Affect through (1.1) Sensorial Aesthetics and (1.2) Novelty

Sensual attributes of digital objects reveal reliance on the users' visual perception in assessing physical characteristics such as image quality, perception of texture, and unique features. The manipulation of digital objects is translated through zooming in and out or scrolling up and down to assist the user in interpreting the objects. Although the interface is not the primary focus of the study, it is a critical component in the digital experience. Participants elaborate: "I wish I could reach in the screen and touch things" (Par_A.diph.09), and "there were some things that were so much more vibrant in the [digital] photograph, that I don't think I noticed when I went through the first time [physical]" (Par_B.phdi.15). Manipulating the digital object as a way to study the images was expressed numerous times, for example: "All the images scrolling through them [online slideshow] . . . that was amazing" (Par_A.diph.06); "Certainly if I zoomed in I could identify that the eyes are marble" (Par_A.diph.05), or "I think the only thing that made it more interactive [altered book] was kind of that ability to look from page to page [online slideshow]" (Par_A.phdi.20).

Documentation was considered novel to some of the users. One noted that "the background on the photographer is novel" (Par_A.phdi.12), while another user saw the information about the creator as novel. Aesthetics also played a role in novelty. A user commented: "It caught my eye just 'cause it was a foreign thing. It was an interesting object . . . complex and interesting" (Par_A.diph.02). Most participants, overall, felt the digital photographs and buttons were comparable and sufficient in this platform. One said, "The pictures and the buttons [were] . . . really straightforward. And they evoked the same emotions as it would if I was like looking at it physically—in the physical world" (Par_A.diph.09). Some participants did not pick up the physical photographs, explaining: "I didn't really pick the pictures up because I didn't feel they needed to be picked up" (Par_A.diph.06).

While users relied on their visual perception and the computer interface to manipulate the digital images, users with the physical objects relied on their multi-sensory abilities to create an immediate sensorial affect. One commented: "I took in the whole thing as an artifact in itself and just saw it was interesting and complex . . . the book, I like that you could delve into it. It's just like very intriguing" (Par_A.diph.02).

User experience with physical and digital objects were similar but for different reasons. Sensorial qualities of the digital surrogates were described through the users' visual perception in recognizing the beauty and novel characteristics of the objects. Manipulation of these objects relied on the interface. The sensorial qualities of physical objects had the additional attributes of sound and touch. These objects were described through visual aesthetics, the feel of the objects, and physical manipulation, giving the user a multi-sensory experience that engaged more of the cognitive senses through mental activities such as thinking or reasoning see (see table 6).

Table 6. The Sensual Affect through (1.1) Aesthetics and (1.2) Novelty		
	Digital Surrogates	Physical Objects
Relies on	Visual Perception Computer Interface	Visual, Touch, Sound Physical Manipulation
Type of connections	Visual beauty/Novelty	Multisensory Experience: Visual Beauty + Touch and Feel + Cognitive Engagement. Novelty.

Emotional Affect through (2.1) Inquisitive Thinking and (2.2) Emotions/Feelings

Inquisitive thinking (2.1) is to be intellectually curious to know more about the object. This includes reflection upon the object to create meaning. Emotions and feelings (2.2) included joy, sadness, satisfaction, and excitement.

Users were highly engaged with the documentation in the digital platform. They were both inquisitive and self-reflective, asking questions about the history of the object, such as "who is the creator" or "what motivated the collector?" One participant said, "I was thinking in my mind . . . Malaga Island and it dawned on me how much he has in his collection on that . . . that's the part of it that crossed my mind because I looked at that and I say he's made this effort to document . . . did he document the ugly as well as the good? And if he did make that effort, did he make a conscious effort?" (Par_B.diph.08).

Users' experiences with the physical objects encouraged inquisitive thinking and self-reflection but users were not as highly engaged with the documentation. Many of the participants used the physical object as their primary source of information. "I didn't understand until I was actually playing with the book that there's like pieces of maps spread all over it," one user noted. "It's like literally the world is upside down because it's so chaotic. So you're turning the thing around to . . . people to read where the places are on the map and they're all blown apart and then later, there's like a fuller version of the map and I just thought that was interesting. I found myself reading over this and want to know more about who made it . . . there was so much to see and so much to wonder why they made the artistic choices that they made in compiling this book together. I just felt like it was really significant" (Par.A.phdi.10).

Both platforms shared similar experiences in inquisitive thinking. However, words describing positive and negative emotions and feelings were more varied in their intensity when describing the physical collection (see table 7).

Table 7. The Emotional Affect through (2.1) Inquisitive Thinking and (2.2) Emotions/Feelings		
	Digital Surrogates	Physical Objects
Relies on	Context/Content	Context, Visual, Physical Manipulation
Type of Connections	Inquisitiveness Self-Reflection Positive Emotions (incredible, meaningful) Negative Emotions (sad, gutted)	Inquisitiveness, Self-Reflection, Positive Emotions (fascinating, glad, overwhelming, pleasure) Negative Emotions (afraid, angry, confused, nervous, sad, scared, worried, unpleasant)

Spatiotemporal Affect through (3) Connections

Users construct meaning in relation to objects by connecting events through lived experiences. This occurs through the process of interpretation, first through the use of the physical body and senses to understand the new information, and then by relating with the object through use of past knowledge by the mind.[17] Users made connections with both digital and physical objects. Some users shared memories of past events in their lives. One related that "the LGBT collection [digital] evoked a memory of when my friend . . . first told me that he wanted to become a woman. And that was like 2005 or 2006. And I thought it was just like a phase, just a thing [pauses] he's a woman. He now takes the hormones" (Par_A.phdi.9). Some users connected with physical objects because it related to their work or personal interests, saying, "And the penicillin. I am a nurse so the idea of it . . . I see, the inhalant . . . an interesting concept. Was it effective?" (Par_B.phdi.16), or "Back in the '60s I was involved in the gem trade so that intrigued me . . . wondering where this came from" (Par_B.diph.08). And for others, the connections were quite personal: "I definitely had much more internal feelings towards this book mainly because some of the letters, especially when looking through it and reading some of the notes. They are very similar to notes I wrote as a child to my father. And that really brought back memories" (Par_B.diph.04). Participants constructed meaning for the objects through personal memories, reflection, and life experiences (see table 8).

Table 8. The Spatiotemporal Affect through (3) Connections		
	Digital Surrogates	Physical Objects
Relies on	Content, Visual Perception, Interest	Visual, Touch, Physical Manipulation, Interest
Type of Connections	Memories, Recollections	Memories, Recollections

[17] Eileen Hooper-Greenhill, *Museums and the Interpretation of Visual Culture* (London: Routledge, 2000), 116.

Numinous Affect through (4) Transformation

The numinous experience of transformation is described as awe, wonderment (mysterium tremendum) or fascination (drawn to or transformative). This is a much deeper, more profound affect between the user and the object, in which one transcends oneself and reaches a higher sense of place or spirit. This is the only attribute that did not appear to be experienced by the digital surrogates. Orr makes reference to this as well, stating that a true numinous experience from a website is difficult because of the barrier between the user and the interface.[18] The transformative effect was experienced when engaging with physical objects. Numinous qualities such as loss, death, and hope were a recurring theme. Participants commented: "I thought about my mortality . . . of how the people in the pictures were alive at one time and now they're not and eventually I will be too" (Par_A.diph.09); "The book . . . shown [sic] images of war. My father is a World War II vet . . . so I think for me any time I see some of those images . . . or it may be a letter that evokes for me what he had to experience from a personal perspective . . . very proud and honored and blessed that he came home because so many did not" (Par_B.phdi.15); "The letters and poems . . . the memory that's evoked is from [my] early teens, like ten to thirteen years old when my brother would have been in Vietnam and then back again. I was the youngest at home with my parents so to live with the emotional aspect of that of being there" (Par_B.phdi.16). The numinous qualities of objects can awaken deep emotions—even elicit tears.[19] One user confessed: "At one point I almost got a tear in my eye when I was looking at some of those photos. I felt like being invited into something very intimate" (Par_B.phdi.18) (see table 9).

Users' were very engaged with the highly complex altered book compared to the digital surrogate. Tanselle points out there are two types of information beyond the content—the production of the material and how it was used. These offer insight into the creator of the objects and how the user responds to that creation.[20] One user commented that "the book really felt like specifically a lot to miss if you used the website. I feel like a lot of what the piece means is in the active act of having of going through all that—sort through it . . . there was so much to see and so much to wonder why they made the artistic choices that they made in compiling this book together. I just felt like it was really significant" (Par_A.phdi.10).

Table 9. The Numinous Affect through Transformations (4.1)		
	Digital Surrogates	Physical Objects
Relies on		Visual, Physical Manipulation
Types of Connections		Fascination, Anticipation, Mortality/Death, War, Sadness, Awe

Engagement through Documentation

[18] Tori Orr, "The Information-Seeking Behavior of Museum Visitors: A Review of Literature" (2004): 6, *Toriorr.com*, https://toriorr.files.wordpress.com/2012/01/rol_museumvisitors.doc.
[19] Ibid., 4.
[20] G. Thomas Tanselle, "Uses of Primary Records of the Past," in *Who Wants Yesterday's Papers: Essays on the Research Value of Printed Materials in the Digital Age*, ed. Yvonne Carignan, et al. (Lanham, MD: Scarecrow Press, 2005), 156.

Digital immigrants preferred to read the digital content over print, as was indicated by the Pearson-r correlation analysis. Of the twenty participants, eighteen read all the content provided for the surrogates who showed interest in the backstory of the object. One noted "they gave me some background information that I wouldn't of had if I just sat here [and] looked at the objects" (Par_B.diph.04). Users who engaged with the altered book in its physical form also relied on the digital content for the book. "I'm glad I read the content first," a participant explained, "because I probably would have been confused as I went through it" (Par_A.diph.14). Dorner, Liew, and Yiu stated that for users to interpret digital resources, appropriate context was an important issue.[21]

Engagement with Physical Objects through Complexity and Interest Level

Analysis from the independent two-tailed t-test shows that there are no statistically significant differences in overall time spent between physical and digital. However, when time spent by users on individual physical items is measured, marked differences appear, depending upon the simplicity or complexity of the physical objects and the users interest level—the more interesting or complex the object, the more engaged the user (see table 10). This was found to be evident in a previous pilot study on user engagement with physical objects.[22]

Sequence

Of the twenty participants in this study, ten were digital natives and ten were digital immigrants. Each group of ten was separated into two sub-groups of five. Half would start with the digital surrogates and the other half would start with the physical objects. This was consciously done so as not to give preference to one platform over another. However, it had an influencing effect on the users' experience as indicated in the independent two-tailed t-test. Those who started with the digital collections spent less time with the physical and vice versa (see table 11).

Some of the users were cognizant of this phenomenon:

> I am wondering if I had done this in the opposite order, if things would have been different. I think since I saw digitally first, it kind of primed me first to have a kind of background to go in and have kind of this deeper more meaningful experience with the objects. Excited to see them. I think if I'd seen this first, and then gone to the digital . . . I would have been less interested because I [had] already seen the goods (Par_A.diph.06).
>
> I think it's definitely tainted by the fact that I had the physical things first so it doesn't even come close to as fun. It's not nearly as fun as playing with the physical things and so because I had these things to compare first, looking them on the screen is like, oh that's a poor copy, oh that's unfortunate that I can't, like,

[21] Daniel G. Dorner, Chern Li Liew, and Yen Ping Yeo, "A Textured Sculpture: The Information Needs of Users of Digitised New Zealand Cultural Heritage Resources," *Online Information Review* 31, no. 2 (2006): 181.

[22] Anastasia S. Weigle, "User Engagement with Physical Objects: An Investigation on the Multi-Dimensional Experience of Archival Users," unpublished manuscript, Simmons College, 2013, p. 22.

touch it and see the depth of it. And I hardly even read the placards. (Par_A.phdi.11)

Table 10. Time Analysis on Individual Objects (seconds)								
User ID	**Physical**				**Digital**			
	Photos	**Buttons**	**Mask**	**Book**	**Photos**	**Buttons**	**Mask**	**Book**
A.diph.01	62	24	65	315	175	78	178	244
A.diph.02	0 *[data lost]*	0 *[data lost]*	0 *[data lost]*	208*[partial]*	131	79	140	160
B.diph.03	27	12	28	468	696	69	190	63
B.diph.04	28	23	34	246	107	49	116	286
A.diph.05	46	19	28	245	196	135	310	434
A.diph.06	40	32	59	380	344	60	176	447
B.diph.07	41	30	75	840	363	85	379	982
B.diph.08	26	12	22	96	328	106	254	1659
A.diph.09	33	27	65	133	354	60	193	240
A.phdi.10	150	95	126	1575	143	79	71	406
A.phdi.11	35	13	36	855	61	6	6	178
A.phdi.12	56	20	109	403	67	13	33	139
A.phdi.13	108	42	169	865	295	18	41	684
B.diph.14	43	47	66	569	179	129	229	169
B.phdi.15	78	43	73	585	78	29	82	241
B.phdi.16	79	72	93	553	230	90	143	387
B.phdi.17	108	46	147	284	97	47	96	408
B.phdi.18	91	59	197	1089	175	59	158	375
B.phdi.19	98	61	166	318	108	55	169	156
A.phdi.20	87	81	125	183	99	65	63	114
Sum	1236	758	1683	10210	4226	1311	3027	7772
Avg. Mean	61.8	37.9	84.2	510.5	211.3	65.6	151.4	388.6

Loss of Information through Digital Translation

Although documentation listed intrinsic elements of the physical objects, the digital image did not translate these elements well, causing loss of information. One user commented: “The digital image did not register to me the size until I saw the physical object” (Par_A.diph.01); “If I hadn’t seen the physical one, I wouldn’t have known what the silver thing was” (Par_A.phdi.13). The sensual qualities of the altered book, arising from the various mediums used, provided additional information not easily translated into digital form. Users explained that “looking at an altered book, even though the [digital] pictures are excellent, [is] not nearly the same as getting to take the letters out, take pictures out, look them over” (Par_A.phdi.11); “The book does not look at all what I thought it would look like. It’s much bigger, much more complicated and interesting” (Par_A.diph.02). Engagement through interaction with the object was also lost in the digital form. This loss of information can tell us something about the creator, the construction, and the meaning of the objects (knowledge).

Table 11. Sequence for Time Averages in Seconds

Digital Natives (DN)					
User ID	**Digital 1st**	**Physical 2nd**	**User ID**	**Physical 1st**	**Digital 2nd**
A.diph.01	675	466	A.phdi.10	2008	764
A.diph.02	600	208	A.phdi.11	939	252
A.diph.05	1178	338	A.phdi.12	588	289
A.diph.06	1094	511	A.phdi.13	1265	1061
A.diph.09	915	245	A.phdi.20	484	319
SUM Total	4462	1768	SUM Total	5284	2685
Mean Avg.	892.4	353.6	Mean Avg.	1056.9	537
Median Avg.	915	338	Median Avg.	939	319
Range	578	303	Range	1524	809
Digital Immigrants (DI)					
User ID	**Digital 1st**	**Physical 2nd**	**User ID**	**Physical 1st**	**Digital 2nd**
B.diph.03	1446	535	B.phdi.15	779	480
B.diph.04	521	331	B.phdi.16	797	965
B.diph.07	1821	997	B.phdi.17	765	780
B.diph.08	2490	156	B.phdi.18	1436	820
B.diph.14	761	725	B.phdi.19	582	487
SUM Total	7039	2744	TOTALS	4358	3532
Mean Avg.	1407.8	548.8	SUM Total	871.6	705.4
Median Avg.	1446	535	Median Avg.	779	780
Range	1969	841	Range	855	485

Discussion

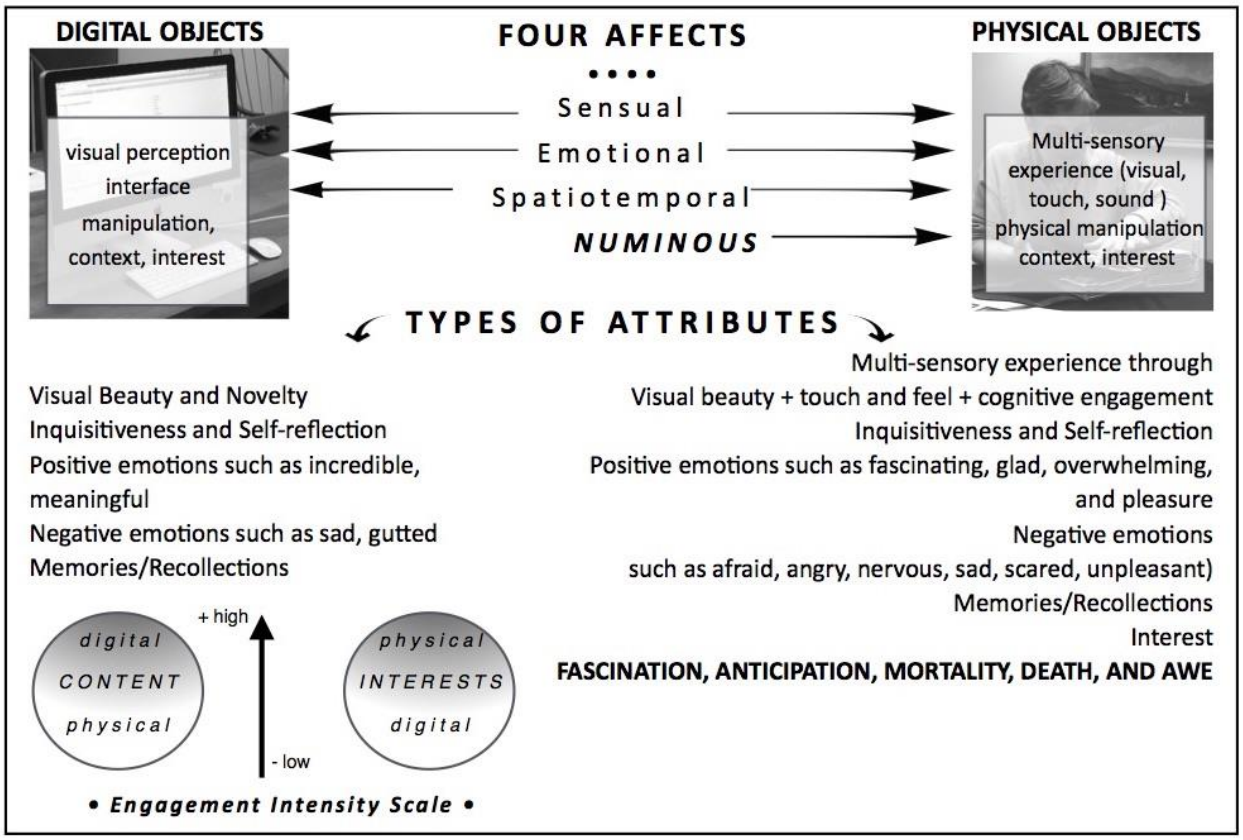
Statistical analysis suggests that when users start with physical collections first, they spend more time on them than the digital collections and vice versa. Overall, the time spent on the digital collections was significantly higher than with physical collections. Correlation analysis results suggest that the older the user is (DI), the more time they will spend studying the digital objects. Statistical analysis also suggests that the users who spent more time on the digital collection tended to rate a higher score for digital use. It did not seem to matter if a user was a DI or DN. The experiences were based on aesthetics, emotions, and meaningful experience, not comfort level or expertise with various technologies.

Physical objects offered a higher level of emotional intensity and engagement for the user based upon the level of interest and complexity of the object. Users were highly engaged with the digital documentation provided with the digital objects. Although supporting documents with the physical objects were important to the user, they did not appear to have the same high level of engagement compared to the digital user. Instead, users were more engaged with the information provided by the physical attributes. Most participants agreed the digital photographs and buttons were a satisfactory alternative to the physical objects. These participants found no difference between the print and digital photographs. For more complex objects, perception of physical

attributes did not always translate well into digital form. Users were surprised at the physical size, weight, or texture of an object when compared to its digital surrogate. This is important to note because some of the unique intrinsic qualities that the physical object contained were lost during digital translation.

Lastly, when measuring the attributes for sensual, emotional, and spatiotemporal affect of user experience, both platforms contained attributes of aesthetics, novelty, inquisitiveness, self-reflection, and connections through memories. However, qualitative analysis revealed that the numinous affect of transformation, such as loss, death, mortality, and hope, was experienced only at the physical level (figure 1).

Figure 1.



Limitations of the Study

There were a number of limitations in this study. First, the variation in sequencing influenced the user's experience. It may be more advantageous in the future to do a comparative study of user experience between physical and digital objects using two separate groups. Second, the representation of the digital surrogates on the website was not comparable because it did not allow users the ability to rotate the three-dimensional objects. The interface was designed to help the user go through the collections with the least amount of difficulty. But the design can be subjective based on the perspective of the designer such as placement of images, use of colors, order of collections, and font type or size. Third, it would have been advantageous to add

additional Likert scales to determine level of interest for each object. This would add a more in-depth quantitative analysis of user experience. Lastly, the "think after" protocol method relied heavily on memory. If a user does not remember, they may fabricate the experience, as was evident with this user's comment: "And I kind of think I've forgotten about some of the digital stuff after having seen the physical. I remember the information but the experience I didn't remember thoroughly" (Par_A.diph.07). Encouraging the "think aloud" process during the sessions is more advantageous as the user can share their experience as it is happening in real time.

Conclusions

The phenomenon of materiality is what authenticity can be defined by—the subjective experience through which the physicality of an object can elicit experiential, meaningful, and affective responses. What is being observed here are the differences between the digital object and the authentic "real" material object. There are subtle elements that can be lost during digital translation. These can be in the form of external features such as notations, color, type, and impressions—elements of intrinsic value that present additional information.[23] Highly complex three-dimensional objects contain non-textual elements that exceed basic media and content, providing additional information about the object that would otherwise be lost in the digital translation.[24]

Some insights into the phenomenon of user experience with physical objects and their digital surrogates were found in this study. Users did not require any special skills in the physical environment to handle objects, making the connection immediate. This allowed the participants to freely concentrate on the object, creating a multi-sensory experience. An additional numinous quality was also experienced with the highly complex physical object. This supports Orr's statement that a true numinous experience from a website is difficult because of the barrier between the user and the interface.[25] Some users experienced the desire to create their own artifacts after handling the highly complex object. This is an example of when object-subject engagement becomes very real to the user.[26] Digital collections required an interface to navigate through the website. The user's attention was divided between their visual perception (what the user was looking at) and moving the mouse up and down to read the content. More time was spent on digital documentation than the digital image, making the engagement less about the object and more about the content. Users not only read all of the documentation provided on the website but some even went outside the website and searched the web. This supports the study by Dorner, Liew, and Yiu, which states that for users to interpret digital resources, appropriate context must be provided.[27] It bears mentioning that studying digital objects can encourage users to experience the physical object. One participant noted, "I think since I saw digitally first, it kind of primed me first to have a kind of background to go in and have kind of this deeper more meaningful experience with the objects" (Par_A.diph.06).

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[23] Angelika Menne-Haritz and Nils Brübach, "The Intrinsic Value of Archive and Library Material," *Microform & Imaging Review* 29, no. 3 (2000): 86–87.
[24] Anne J. Gilliland-Swetland, *Enduring Paradigm, New Opportunities: The Value of the Archival Perspective in the Digital Environment* (Washington, DC: Council on Library and Information Resources, 2000), 11.
[25] Orr, "Information-Seeking Behavior," 6
[26] Sandra Dudley, *Museum Materialities: Objects, Engagements, Interpretations* (London: Routledge, 2010), 5.
[27] Dorner, Liew, and Yeo, "A Textured Sculpture," 181.

Archivists, special collections librarians, and curators should not overlook the experiential elements users sense and feel with digital collections during usability studies based on our understanding of user experience with physical objects. It is the object's unique evidential value and intrinsic qualities that are at risk here. There is no question about the importance of digital collections, but we must also recognize the importance of the user's deep connection through the physicality of information and all its unique elements when assessing collections for digitization. Some objects do not translate well into digital form. Therefore, it is necessary to recognize that not everything can be digitized. Highly complex interactive physical objects contain unique features far too valuable to overlook. It is important to understand the meaning of the deeply connected encounter users have with physical collections for this, too, is an important part of their information journey.

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Appendix A. Semi-Structured Open-Ended Interview Questions

Digital Collections

1. Did you view the images in order based on the navigation bar or randomly?
2. What were you thinking when you first saw the digital images?
    a. How did that make you feel?
3. Did you read any of the content/context?
    a. Was it helpful? b. Did it change your perception of the objects?
4. Which artifact did you spend the most time on and why?
5. Were any of the images novel or interesting—something that caught your attention?
    a. In what way?
6. Did the artifact give you a sense of story or narrative?
    a. How did the narrative make you feel?
7. Did the object evoke some story or memory in you mind?
    a. What was that memory? b. How did that make you feel?
8. Are there any other observations/experiences/feelings you would like to share?

Physical Collections

9. How did the artifact feel in your hands?
    a. What did you notice first (touch, texture, quality, etc.)?

   b. How did the artifact feel when you touched it?
   c. Did you notice any other sensorial qualities? Can you describe them?
10. How did you "read" the artifacts? Did you read the artifact left to right, right to left?
   a. If not, where did your eyes go?
11. Was there anything about the artifact that you found novel or interesting?
   a. Can you describe how the novelty/interest felt?
12. Which artifact did you spend the most time on and why ?
13. How challenging or difficult was it to handle [view] the artifacts?
   a. What made it difficult?